# VIIRS Aerosol Optical Depth
Quick Guide

Why is VIIRS Aerosol Optical Depth (AOD) Important?

VIIRS Aerosol Optical Depth (AOD) is a **quantitative** measure of aerosol loading in the atmosphere. VIIRS AOD is reported at 550 nm, in the middle of the visible spectrum. It is unitless; higher values of AOD indicate higher concentrations of aerosols, including smoke, blowing dust, and haze. This product can help operational users who provide warnings, watches and advisories for dust, smoke, and haze related to visibility and air quality. Imagery can be accessed online via the AerosolWatch and JSTAR Mapper websites.
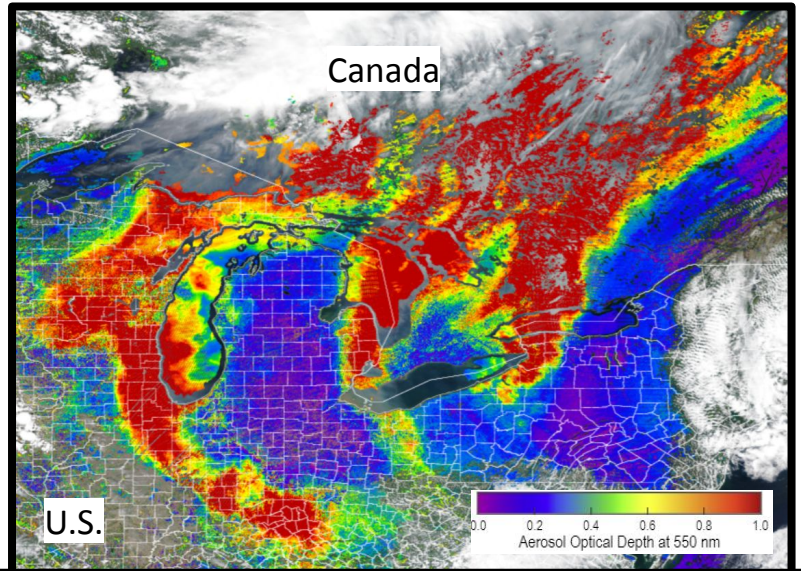
NOAA-20 VIIRS AOD observations of smoke from Canadian wildfires at 19:07 UTC on 4 June 2023. Image from the JSTAR Mapper website.

VIIRS AOD Algorithm and Specifications

Algorithm	Evaluated AOD Accuracy & Precision	Resolutions	Latency
• AOD is calculated separately for land and water using a lookup table of pre-computed values for several atmospheric parameters. For more details, consult the ATBD.	**Low AOD** (AOD < 0.1 over land, AOD < 0.3 over water): • Accuracy: 0.02 (land & water) • Precision: 0.05 (land & water) **Medium AOD** (0.1 ≤ AOD ≤ 0.8 over land): • Accuracy: 0.05 (land) • Precision: 0.15 (land) **High AOD** (AOD > 0.8 over land, AOD ≥ 0.3 over water): • Accuracy: 0.2 (land), 0.05 (water) • Precision: 0.4 (land), 0.15 (water)	**Spatial:** 750m **Temporal:** 1-2 observations per day per JPSS satellite at mid-latitudes; more at higher latitudes.	~ 1 hour

Impact on Operations

Primary Application

Aerosol Monitoring: Identifies the location, movement, and amount of aerosol in the atmosphere. It is a useful proxy for air pollution from natural and anthropogenic sources, including smoke, blowing dust, volcanic aerosols, and haze. AOD can be used in monitoring and forecasting air quality and visibility hazards. AOD does not distinguish the aerosol type. Use ground-based particle pollution measurements (e.g., $PM_{2.5}$, PM_{10}, low-cost sensors) in conjunction with VIIRS AOD to determine if aerosols are impacting surface air quality.

Interpreting AOD Values:
- 0 < AOD ≤ 0.2: clean atmosphere
- 0.2 < AOD ≤ 0.4: thin aerosols
- 0.4 < AOD ≤ 0.6: moderately thick aerosols
- 0.6 < AOD ≤ 1.0: thick aerosols
- AOD > 1: very thick aerosols

Limitations

Daytime Only: Because the VIIRS AOD algorithm uses reflected sunlight, the product is only available during the daytime.
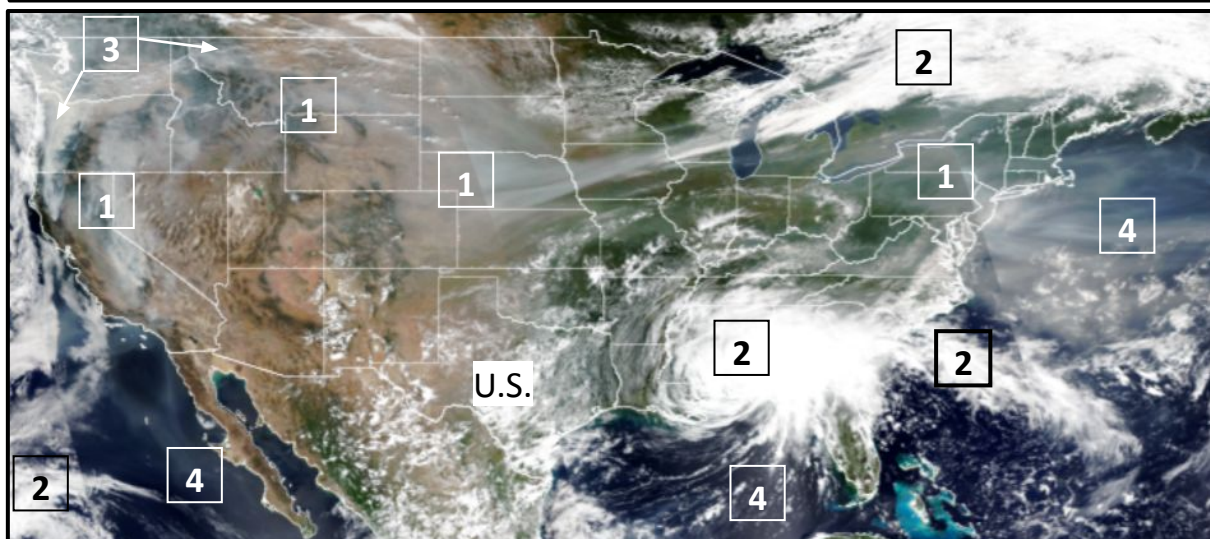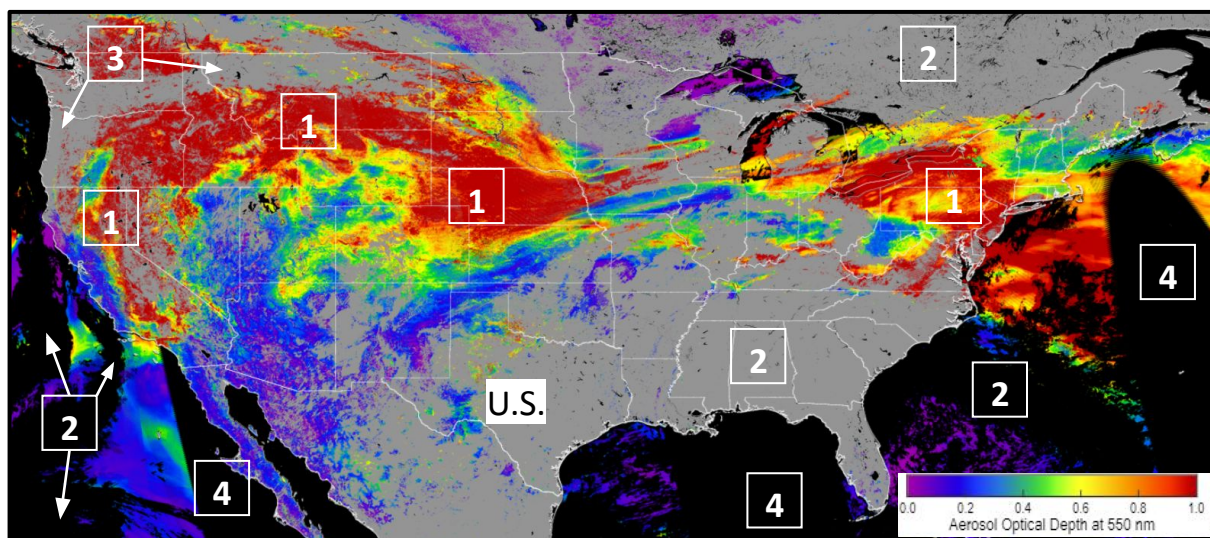
Clouds, Snow, Ice, and Sun Glint: VIIRS AOD is not available for areas covered by clouds, snow, or ice, or for areas of sun glint on water.

AOD can be missing for thick aerosols: Thick aerosol plumes can be misidentified as clouds (due to the Cloud Mask, used as an input to the VIIRS AOD algorithm).

AOD is a vertical column measurement: The AOD product does not identify where the aerosols are located within the vertical profile.

Contributors: CSU/CIRA, NOAA/NESDIS/STAR, GINA, and CIMSS.

Image Interpretation

1 Higher AOD values indicate higher aerosol concentrations

2 AOD is not produced where clouds are present

3 AOD can be missing in thick aerosol plumes

4 AOD is not produced over areas with sun glint on water

Resources

NOAA/NESDIS/STAR
VIIRS AOD Users' Guide

AOD Algorithm Theoretical Basis Document (ATBD)

AerosolWatch Website
Near-Real-Time & Archived VIIRS Aerosol Data over U.S.

JSTAR Mapper Website
Near Real-Time & Archived Global VIIRS Aerosol Imagery

STAR Atmospheric Composition Product Training
Aerosol, Fire, and Trace Gas Satellite Products from ABI, VIIRS, TROPOMI & TEMPO

Hyperlinks not available when viewing material in AIR Tool

NOAA-20 VIIRS AOD (top) and True Color RGB (bottom) images of wildfire smoke in the Continental U.S. on 16 September 2020. Images from the JSTAR Mapper website.
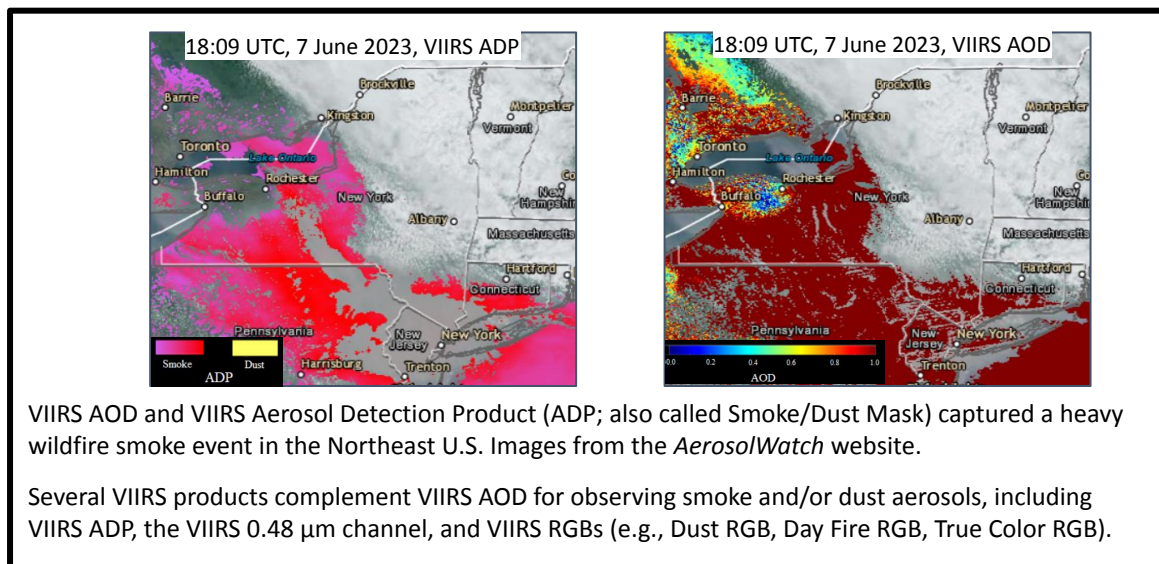
VIIRS AOD and VIIRS Aerosol Detection Product (ADP; also called Smoke/Dust Mask) captured a heavy wildfire smoke event in the Northeast U.S. Images from the *AerosolWatch* website.

Several VIIRS products complement VIIRS AOD for observing smoke and/or dust aerosols, including VIIRS ADP, the VIIRS 0.48 μm channel, and VIIRS RGBs (e.g., Dust RGB, Day Fire RGB, True Color RGB).